

CLAIMS

2 1. A circuit for adjusting the duty cycle of a PWM signal, comprising:

3 a battery current control section generating a current control signal proportional to

4 an amount a battery charging current exceeds a predetermined battery charging current

5 threshold; a battery voltage control section generating a voltage control signal

6 proportional to an amount a battery voltage exceeds a predetermined battery voltage

7 threshold; a compensation capacitor and a current source charging said compensation

8 capacitor; and a comparator generating a PWM signal based on the amplitude of the

9 voltage on said compensation capacitor; said current source and said current control

10 signal and voltage control signal summed together at a common node, said current

11 control signal and/or said voltage control signal reducing the voltage on said

12 compensation capacitor thereby reducing the duty cycle of said PWM signal.

13 2. A circuit as claimed in claim 1, further comprising a power control section

14 generating a power control signal proportional to an amount of total current that is

15 required by an active system and a battery charger; said current source and said current

16 control signal and voltage control signal and said power control signal summed together

17 at said common node, said current control signal and/or said voltage control signal and/or

18 said power control signal reducing the voltage on said compensation capacitor thereby

19 reducing the duty cycle of said PWM signal.

20 3. A circuit as claimed in claim 2, wherein said power control section comprises a

21 sense amplifier for sensing the total current generated by said source and generating a

22 signal indicative of said total current generated by DC source, and a transconductance

1 amplifier comparing said signal indicative of said total current generated by said source
2 with a predetermined power threshold signal.

3 4. A circuit as claimed in claim 3, wherein said power control signal has a nonzero
4 value if said signal indicative of said total current generated by said source exceeds said
5 power threshold signal.

6 5. A circuit as claimed in claim 1, wherein said current control section comprises a
7 sense amplifier for sensing charging current supplied to said battery and generating a
8 signal indicative of charging current supplied to said battery, and a transconductance
9 amplifier comparing said signal indicative of charging current supplied with a
10 predetermined charging current signal and generating said current control signal.

11 6. A circuit as claimed in claim 5, wherein said current control signal has a nonzero
12 value if said signal indicative of charging current supplied to said battery exceeds said
13 predetermined charging current signal.

14 7. A circuit as claimed in claim 1, wherein said voltage control section comprises a
15 summing block generating a predetermined battery voltage signal, and a
16 transconductance amplifier comparing said signal indicative of battery voltage with said
17 predetermined signal and generating said voltage control signal.

18 8. A circuit as claimed in claim 7, wherein said summing block having a first input
19 signal comprising a reference voltage signal, said reference signal being selected in
20 accordance with a threshold voltage for said battery, a second input signal comprising a
21 battery voltage setting signal, said battery voltage setting signal being generated by said
22 battery, and a third input signal comprising a voltage correction signal, said voltage
23 correction signal compensating for parasitic capacitance of said battery, wherein said

1 summing block providing a weighted sum of said first, second and third input signals to
2 generate said battery voltage threshold signal.

3 9. A circuit as claimed in claim 1, further comprising an oscillator generating a fixed
4 frequency sawtooth signal, said comparator comparing said sawtooth signal and said
5 amplitude of the charge on said charge capacitor and generating said PWM signal having
6 a duty cycle adjusted by said amplitude of the charge on said charge capacitor.

7 10. A circuit as claimed in claim 1, further comprising a Buck DC/DC converter
8 circuit coupled to a plurality of switches and a DC power source, said PWM signal
9 controlling the conduction states of said switches to control the duty cycle of said Buck
10 converter to adjust the amount of charging current delivered to said battery from said DC
11 power source.

12 11. A circuit as claimed in claim 5, wherein said sense amplifier comprising an
13 operational amplifier coupled in parallel to a sense resistor, said operational amplifier
14 sensing the current through a sense resistor, said current through said sense resistor
15 indicative of said current supplied to said battery; a switch coupled between one input of
16 said operational amplifier and ground, the conduction state of said switch being
17 controlled by the output of said operational amplifier; and first and second gain resistors
18 placed between said sense resistor and said one input of said operational amplifier, and
19 between said switch and a reference node, respectively; wherein said signal indicative
20 said charging current supplied to said battery being taken from a node between said
21 second resistor and said switch.

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1 12. A circuit as claimed in claim 2, wherein said active system comprising a portable
2 computer.

3 13. A circuit as claimed in claim 3, wherein said DC source comprises an AC/DC
4 adapter.

5 14. A battery charging circuit, comprising:

6 a current control circuit generating a current control signal proportional to the
7 amount battery charging current exceeds a predetermined battery charging current
8 threshold;

9 a voltage control circuit generating a voltage control signal to the amount battery
10 voltage exceeds a predetermined battery voltage threshold;

11 a DC/DC converter circuit generating said battery charging current from a DC
12 source;

13 a PWM signal generator circuit generating a PWM signal for controlling the duty
14 cycle of said DC/DC converter circuit, said PWM circuit comprising a comparator, an
15 oscillator, a compensation capacitor and a current source charging said compensation
16 capacitor;

17 said comparator generating said PWM signal based on the voltage on said
18 compensation capacitor; said current source and said current control signal and voltage
19 control signal summed together at a common node, said current control signal and/or said
20 voltage control signal reducing the voltage on said compensation capacitor thereby
21 reducing the duty cycle of said PWM signal and thereby reducing the current delivered
22 by said DC/DC converter circuit.

- 1 15. A circuit as claimed in claim 14, further comprising a power control section
2 generating a power control signal proportional to an amount of total current that is
3 required by an active system and a battery charger; said current source and said current
4 control signal and voltage control signal and said power control signal summed together
5 at said common node, said current control signal and/or said voltage control signal and/or
6 said power control signal reducing the voltage on said compensation capacitor thereby
7 reducing the duty cycle of said PWM signal.
- 8 16. A circuit as claimed in claim 15, wherein said power control section comprises a
9 sense amplifier for sensing the total current generated by said source and generating a
10 signal indicative of said total current generated by DC source, and a transconductance
11 amplifier comparing said signal indicative of said total current generated by said source
12 with a predetermined power threshold signal.
- 13 17. A circuit as claimed in claim 16, wherein said power control signal has a nonzero
14 value if said signal indicative of said total current generated by said source exceeds said
15 power threshold signal.
- 16 18. A circuit as claimed in claim 14, wherein said current control section comprises a
17 sense amplifier for sensing charging current supplied to said battery and generating a
18 signal indicative of charging current supplied to said battery, and a transconductance
19 amplifier comparing said signal indicative of charging current supplied with a
20 predetermined charging current signal and generating said current control signal.
- 21 19. A circuit as claimed in claim 18, wherein said current control signal has a nonzero
22 value if said signal indicative of charging current supplied to said battery exceeds said
23 predetermined charging current signal.

- 1 20. A circuit as claimed in claim 14, wherein said voltage control section comprises a
2 summing block generating a predetermined battery voltage signal, and a
3 transconductance amplifier comparing said signal indicative of battery voltage with said
4 predetermined signal and generating said voltage control signal.
- 5 21. A circuit as claimed in claim 20, wherein said summing block having a first input
6 signal comprising a reference voltage signal, said reference signal being selected in
7 accordance with a threshold voltage for said battery, a second input signal comprising a
8 battery voltage setting signal, said battery voltage setting signal being generated by said
9 battery, and a third input signal comprising a voltage correction signal, said voltage
10 correction signal compensating for parasitic capacitance of said battery, wherein said
11 summing block providing a weighted sum of said first, second and third input signals to
12 generate said battery voltage threshold signal.
- 13 22. A circuit as claimed in claim 14, further comprising an oscillator generating a
14 fixed frequency sawtooth signal, said comparator comparing said sawtooth signal and
15 said amplitude of the charge on said charge capacitor and generating said PWM signal
16 having a duty cycle adjusted by said amplitude of the charge on said charge capacitor.
- 17 23. A circuit as claimed in claim 14, wherein said DC/DC converter circuit comprises
18 a Buck DC/DC converter circuit coupled to a plurality of switches and a DC power
19 source, said PWM signal controlling the conduction states of said switches to control the
20 duty cycle of said Buck converter to adjust the amount of charging current delivered to
21 said battery from said DC power source.
- 22 24. A circuit as claimed in claim 18, wherein said sense amplifier comprising an
23 operational amplifier coupled in parallel to a sense resistor, said operational amplifier

1 sensing the current through a sense resistor, said current through said sense resistor
2 indicative of said current supplied to said battery; a switch coupled between one input of
3 said operational amplifier and ground, the conduction state of said switch being
4 controlled by the output of said operational amplifier; and first and second gain resistors
5 placed between said sense resistor and said one input of said operational amplifier, and
6 between said switch and a reference node, respectively; wherein said signal indicative
7 said charging current supplied to said battery being taken from a node between said
8 second resistor and said switch.

9 25. A circuit as claimed in claim 18, wherein said circuit operates in voltage mode by
10 placing said sense resistor in parallel with said DC/DC converter for sensing said
11 charging current supplied to said battery.

12 26. A circuit as claimed in claim 14, wherein said DC/DC converter circuit comprises
13 a Buck converter comprising an inductor in parallel with a capacitor.

14 27. A circuit as claimed in claim 15, wherein said active system comprising a portable
15 computer.

16 28. A circuit as claimed in claim 14, wherein said DC source comprises an AC/DC
17 adapter.